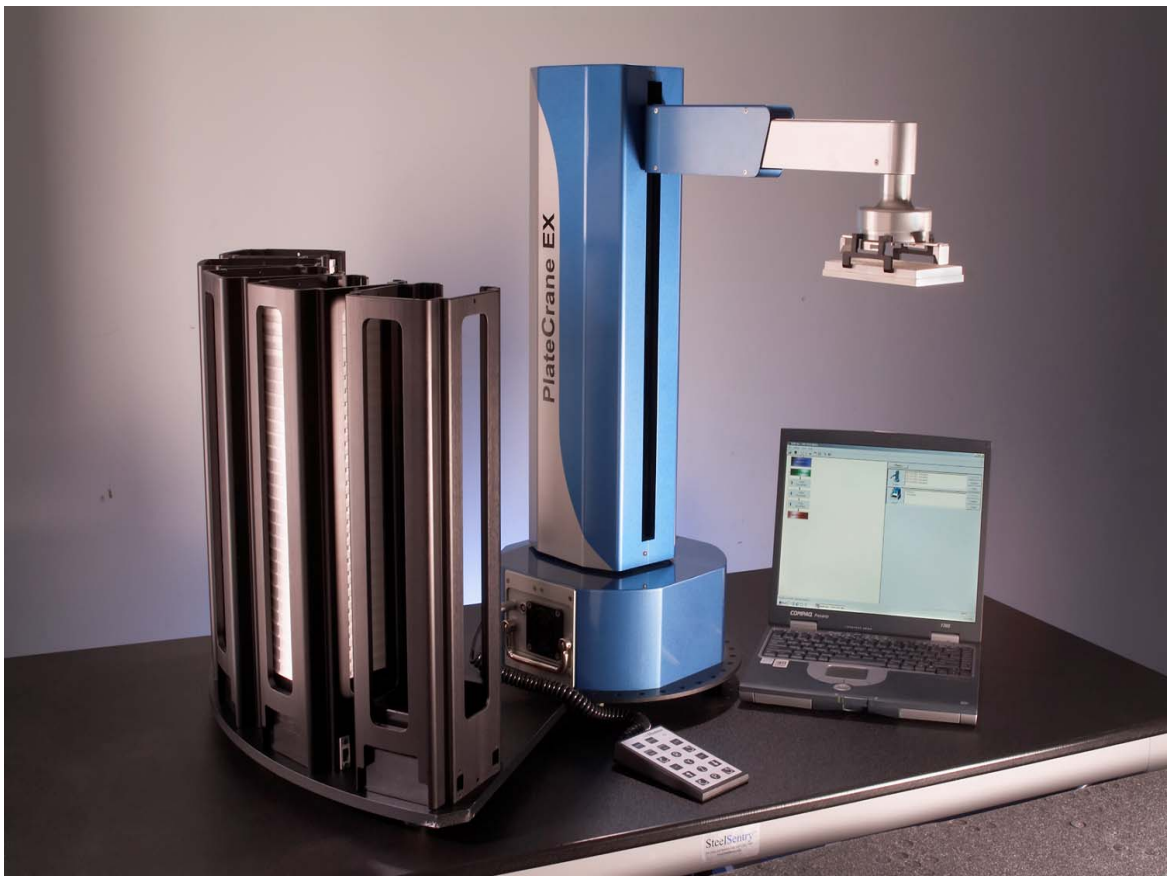
PLATECRANE EX™

SOFTLINX

USER MANUAL



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WARNING- -

This product may be used only in the manner described in this manual.

When used other than as specified, the safety protections provided by the equipment may be impaired.

TABLE OF SYMBOLS:

The following symbols are to alert your attention to important information or warnings that may present some hazards. These symbols may not appear in the manual or on the product.

WARNING	Possible hazardous situation could result in serious injury.
NOTE	A statement that is cautionary; operating tip; instrument damage may occur if not followed.
HINT	Helpful hints and additional information
LIST	List of instructions; parts
■	Important information
♦	Specifications
CAUTION	Electrical Hazard

CHAPTER 1--Introduction

Overview

The PlateCrane EX (See Figure 1) is a multifunctional Pick & Place instrument with a cylindrical robotic work envelope. It is designed to provide a simple answer to automating laboratory instruments that employ microtiter plates. The PlateCrane EX is a small and portable robotic system capable of handling up to thirty 96-well, 384-well or 1536-well microtiter plates per stack with a maximum capacity of 450 plates (15 stacks). The PlateCrane EX has the ability to rotate up to a maximum of 345° about its base axis.

The standard software provided with the PlateCrane EX is called Softlinx and can run multiple instruments in an easy to use "GUI" interface. Softlinx is written in the Visual Basic for Applications programming language and can run on the Windows NT 4.0 w/Service Pack 6, Windows 98, Windows 2000, and Windows XP operating systems. The PlateCrane EX can be interfaced with readers, washers, liquid handlers, labelers, pipettors, etc. To prevent sample contamination, the PlateCrane can handle microtiter plates with lids in conjunction with user defined input/output stacks.

The PlateCrane EX is equipped with a Rotary Gripper and an extendable arm. With the Rotary Gripper, the PlateCrane EX can handle plates in both portrait or landscape configuration. The Rotary Gripper provides maximum flexibility with a 350° axis of rotation. With the extendable arm, the PlateCrane EX has an additional 6” of travel. With the additional 6” travel, the PlateCrane EX can now access nests anywhere within a 12”-18” radius from the center of its base. The PlateCrane EX also has two options AutoTeach vision system (See Figure 3) and the EasyTeach teaching pendant (See Figure 2). The vision system is a camera that attaches to the Gripper. When used with the vision teaching plates the software will calibrate the stacks and instruments on its own. The teach pendant is a pendant that plugs into the PlateCrane and by the push of a button can control any axis on the PlateCrane.

The PlateCrane setup and programming procedures are designed to be simple and intuitive, requiring no more automation expertise than is required to operate a typical plate washer or reader.

Figure 1

EasyTeach

Figure 2

AutoTeach

Figure 3

Computer Requirements

The following are recommended for proper operation of the PlateCrane EX and Softlinx:

- Windows OS (98 SE, ME, NT4.0 SP6, 2000 professional, XP professional or home edition)
- 300 MHz Pentium processor or faster, 128 MB RAM or higher, 3½" floppy drive, CD-Rom drive
- 100 MB of free disk space available
- Internet explorer version 5.0 or above
- Computer with the appropriate number of working serial ports

Stack

Figure 4

Magazine Base

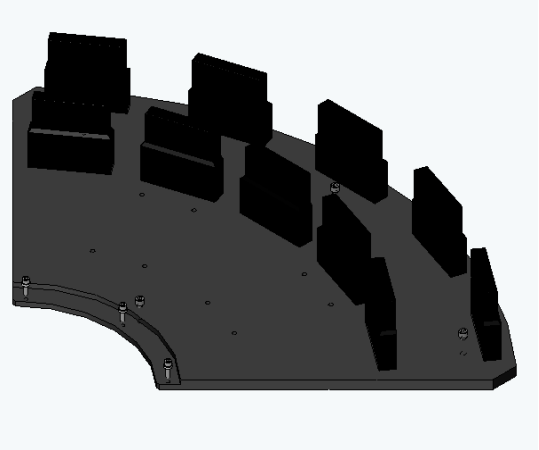

Figure 5

Crane w/Stacks

Figure 6

CHAPTER 2--Installation

Unpack the PlateCrane EX

WARNING- -

Power switch must be turned OFF during entire installation procedure

DO NOT loosen or tighten any screws or touch parts not specified in the instructions

Never force any component to fit

The PlateCrane weighs ≈45 lbs. and should be handled with care to avoid mishaps

Overview:

1. Remove PlateCrane EX from carton (place right arm underneath PlateCrane tower and the left arm underneath the PlateCrane base. Once you have a good hold on the unit gently lift the unit straight up. Make sure that the PlateCrane is separated from the shipping foam. If you have a problem removing the PlateCrane use two people to lift the PlateCrane out of the Box. One Person should lift the tower while the other person lifts the base.)
2. Position the PlateCrane EX
3. Attach Magazine Base(s) to Crane Base (see Figure 6)
4. Install Stack(s) onto Stack Base (see Figure 6)
5. Connect power cord and communication cable to PlateCrane (see Figure 7)
6. Install Softlinx Software (see Chapter 3)

NOTE:

Please refer to parts list to verify that all parts are included in the PlateCrane carton. If any parts are missing, please contact Hudson Control Group (see Chapter 7 for Technical Support).

DO NOT DISCARD the PlateCrane carton. This carton has been specially created for this product and **must** be used for any additional shipping of the instrument to prevent damage.

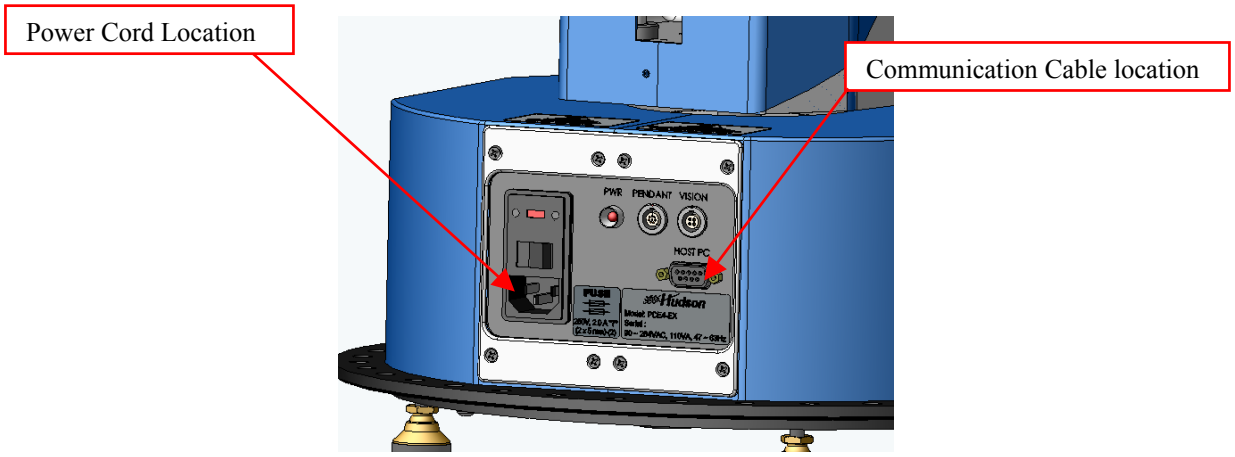

Figure 7

The Stacks can only be installed in one direction. The open side of the stack (Figure 8) needs to be facing the PlateCrane EX and the closed end must face the user (Figure 9). In Figure 10 you can see which way the stacks should be seated on the PlateCrane's magazine base: with the "open" side facing inward, toward the PlateCrane.

Figure 8

Figure 9

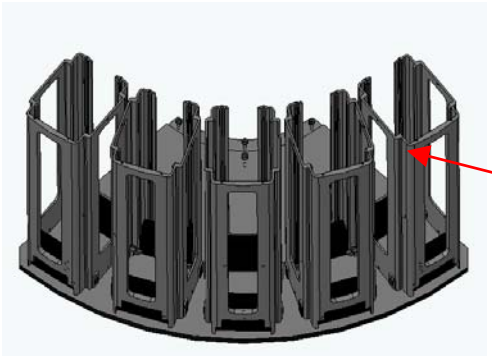

Figure 10

Parts List

The PlateCrane EX carton(s) should include the following:

- PlateCrane EX
- 2 Extruded Stacks (additional Stacks optional)
- Stack Base (additional Bases optional)
- Power cord
- Communication cable
- User Manual (This document)
- CD containing Softlinx and interfaces
- Teaching plate(s)
- Alignment Bases for instrument(s) (optional)
- Gripper jaws for PlateCrane Gripper (Includes Allen Wrench)
- Centering Plate for PlateCrane Gripper (Includes Allen Wrench)
- Allen screws to attach Bases to PlateCrane
- Allen Wrench for Stack and Alignment Base(s)

Setting Up The PlateCrane EX

- Remove PlateCrane EX from the carton and carefully remove the protective plastic covering.
- Unwrap Stack Base and place it near the PlateCrane.
- Remove the Stacks from the carton, then remove the stack from the packaging
- Install the supplied Stack and Alignment Base(s), by securing then to the crane base using the supplied screws.
- Adjust the leveling feet on the PlateCrane EX and Stack Base(s) as required by the surface that they are installed upon.

Connect Power Cord & Communication Cable:

Note: **Power switch must be turned OFF (Figure 11)**

Remove power cord and communication cable from PlateCrane carton.
On the rear side of the base unit housing connect one end of the 9-pin to 9-pin serial cable (see Figure 7), and attach the other end into COM1 port on Host Computer.
Plug power cable into the PlateCrane's AC inlet located on rear side of the base unit housing (see Figure 7).

Note: The communication cable & power cord should be securely plugged into the PlateCrane and computer.

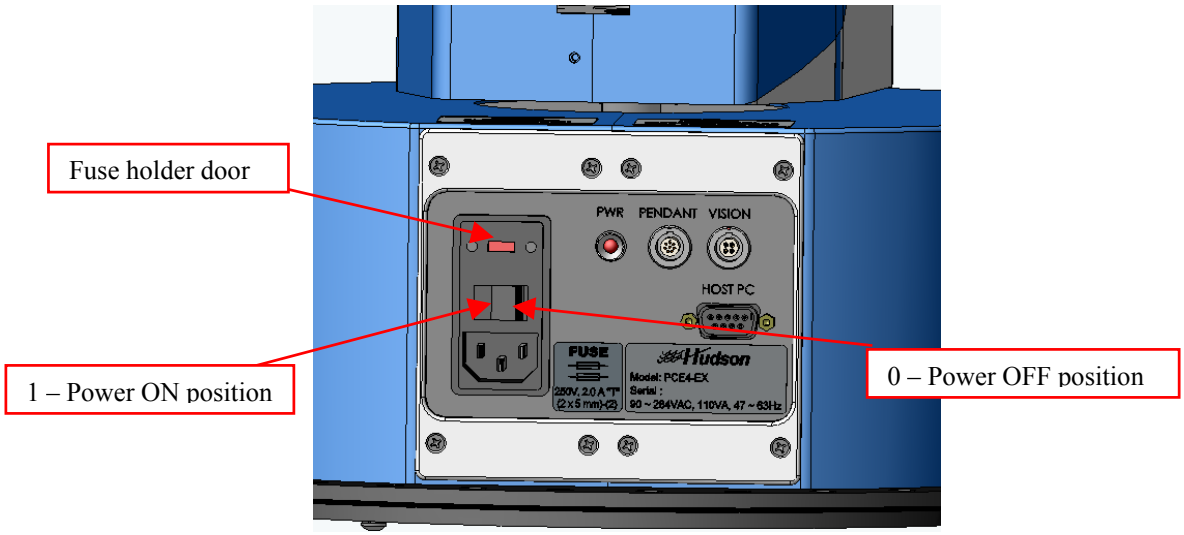

Figure 11

Switching AC Line Voltage 110VAC/220VAC

The power supplies installed in the unit are switching power supplies. That means they are able to handle both 110VAC and 220VAC without any changes to their configuration. The Run the PlateCrane on 220VAC perform the following:

- Make sure the unit is powered off
- Install the power cord that is supplying the 220VAC
- Turn on unit

There is no other setup for the PlateCrane after this.

Installing PlateCrane Stacks:

Note: Mishandling of plate stacks can result in misalignment.

- Unpack and unwrap the input/output stacks
- Mount the stacks onto the stack base by gently sliding them down onto the stack guide blocks.

Installing Barcode Scanner:

- If the Barcode Scanner option was purchased, position the scanner stand just outside the outer edge of the plate magazines, so that a plate's label can be scanned above the top of the stacks.
- Secure the scanner platform to the scanner stand post, and run its RS-232 cable to an available COM port on the host computer. Plug its 5-VDC power supply into a nearby 120 VAC receptacle.

Unplugging Power and Communication Cables:

During service or moving the unit will have to have the power and communication cable removed. To unplug the two cables perform the following:

- The Rear of the PlateCrane should be facing you (See figure 11)
- Unplug the power cable by holding the power cable as close to the PlateCrane as possible and pulling gently straight away from the PlateCrane
- Unplug the communication cable by loosening the two thumbscrews that secure the cable to the PlateCrane then slowly pull the cable straight away from the PlateCrane.

CHAPTER 3—PlateCrane EX Software

Brief Description of Software

Hudson's standard PlateCrane application software (Software) can be found on one (1) installation CD. This CD can be loaded onto any PC running Microsoft's Windows 98 SE, NT 4.0. w\service pack 6, 2000, or XP. This software provides a complete set of utilities to run the PlateCrane EX and any instruments purchased by the end user. Hudson's SoftLinx is an easy-to-use, dynamic scheduling software program for control of integrated lab automation workcells and systems. SoftLinx includes a multitasking core executable combined with device interfaces that are written in VBA (Visual Basic for Applications). The user sets up a method using a drag-and-drop icon-based method editor.

How to Install Software

- ☞ Turn computer ON. Start Windows, if it's not already running.
- ☞ Insert CD into cd-rom drive, and then close the drawer
- ☞ The CD has an auto run function, so the installation of the software is automatic
- ☞ If the CD does not auto run, then click on the Start menu
- ☞ Click the run menu, then type in the location of the CD and Setup.exe (E:\Setup.exe)
- ☞ Then click OK to start installation
- ☞ Follow instructions as prompted to complete the installation.

After installing SoftLinx, open it by clicking the shortcut installed on your desktop. Then click on the Help tab (Figure 12), and then click on help topics (Figure 13). This Help document will tell you step by step how to setup your SoftLinx Workcells. If you have any difficulty with the installation of your software or the configuration of the workcells, please contact Hudson Control Group.

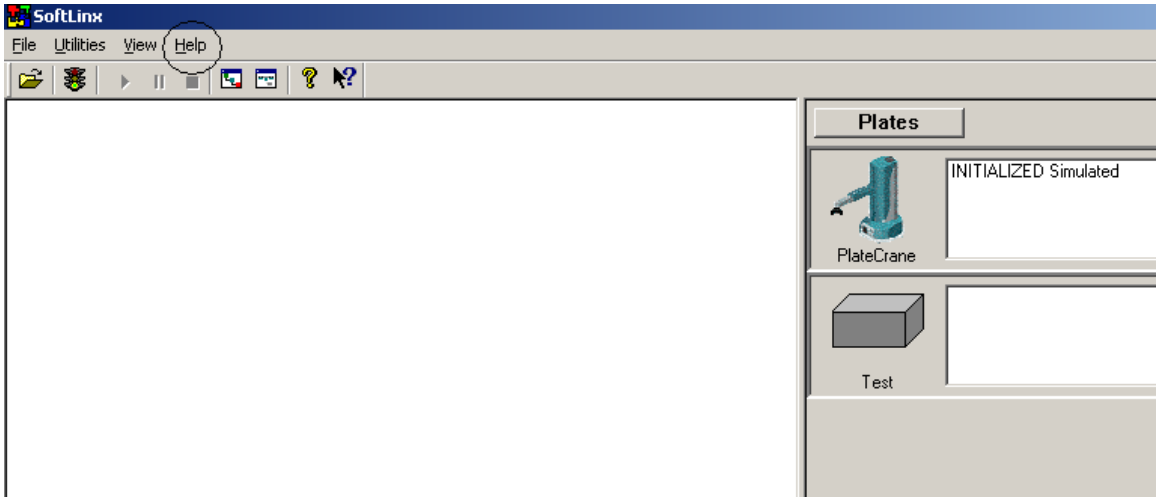

Figure 12

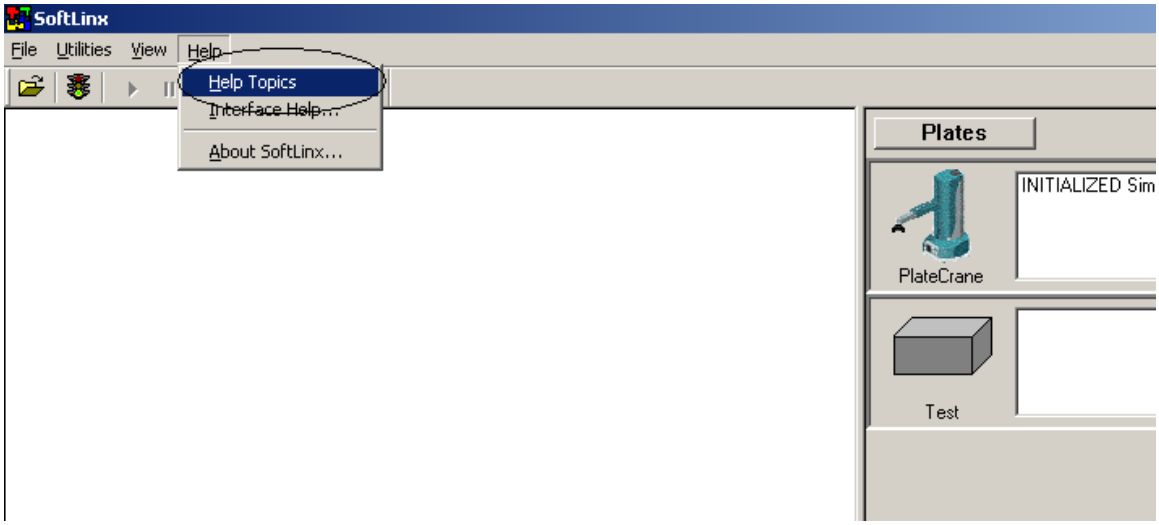

Figure 13

CHAPTER 4--Operation

SoftLinx provides an onscreen User Manual as part of the PlateCrane's "Help" utility.

To access this, click and release the button on SoftLinx's main toolbar, shown here:

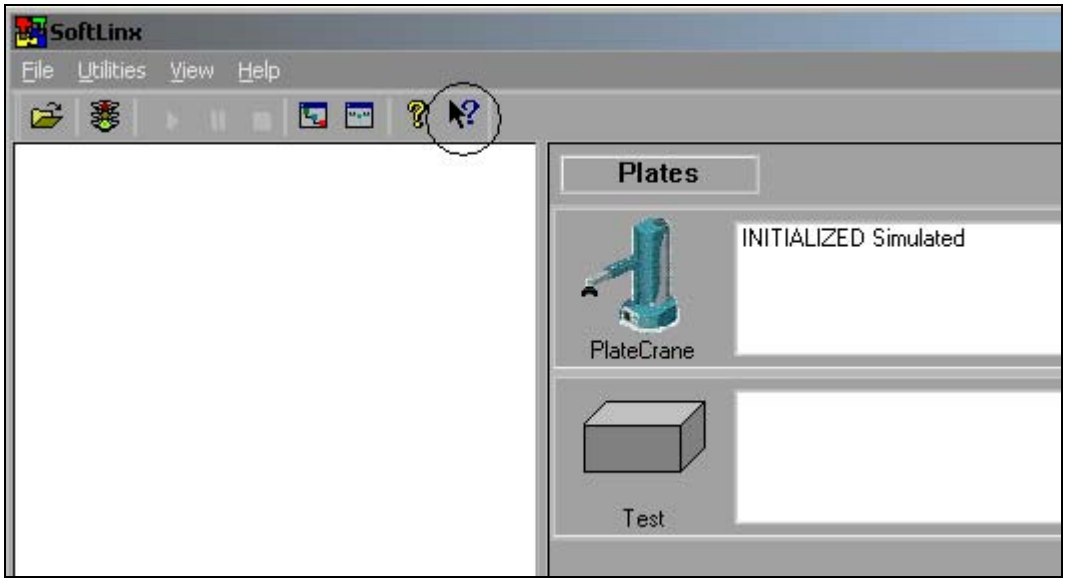

Figure 14

Move the mouse cursor over the PlateCrane bitmap, and then click again to obtain the Help Menu for instruments in your workcell as shown below:

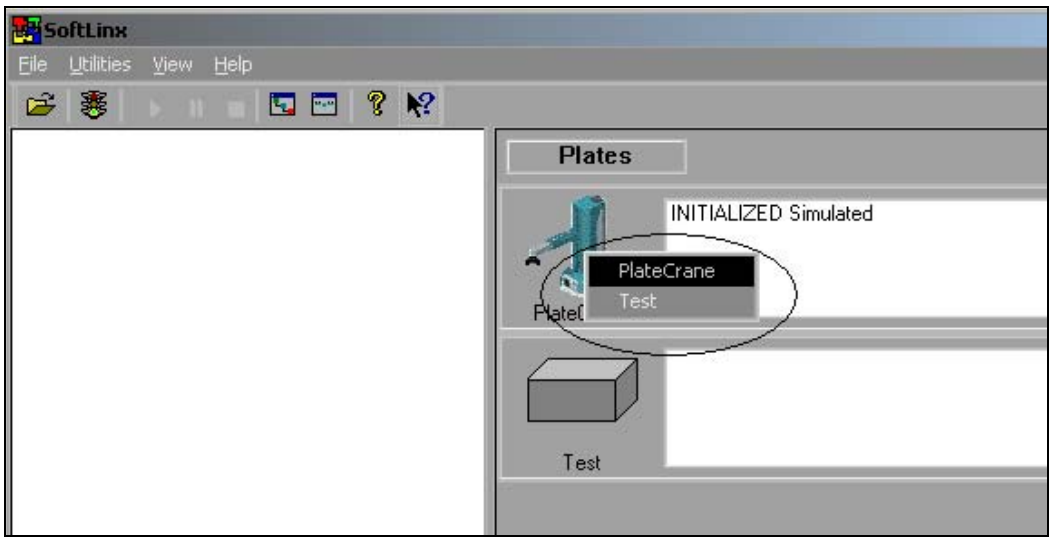

Figure 15

Select "PlateCrane" and the PlateCrane's "Help" screen will be displayed:

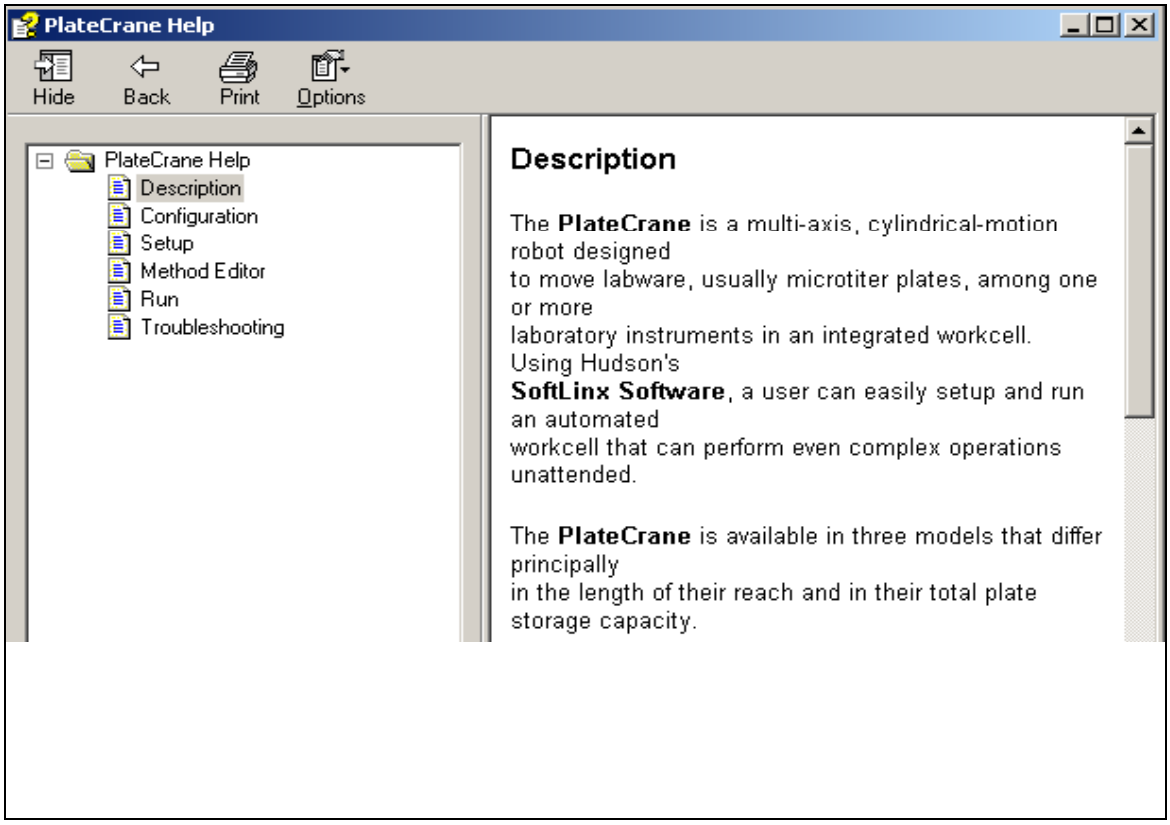
PlateCrane Help
Hide
Back
Print
Options
PlateCrane Help
Description
Configuration
Setup
Method Editor
Run
Troubleshooting
Description
The PlateCrane is a multi-axis, cylindrical-motion robot designed
to move labware, usually microtiter plates, among one or more
laboratory instruments in an integrated workcell.
Using Hudson's
SoftLinx Software, a user can easily setup and run an automated
workcell that can perform even complex operations unattended.
The PlateCrane is available in three models that differ principally
in the length of their reach and in their total plate storage capacity.

Figure 16

You can now select the topic of interest from the six choices in the "tree" in the left-hand screen panel:

Description - provides an overview of the PlateCrane.
Configuration - describes how to set the PlateCrane's serial port and operating mode.
Setup - describes how to create and teach PlateCrane positions and movement paths.
Method Editor - describes how to incorporate PlateCrane activities into a SoftLinx method.
Run - describes how to start and run a method, which uses the PlateCrane.
Troubleshooting - describes some common errors/problems and their likely causes.

You can also print any or all of the above topics to obtain a hardcopy of the PlateCrane's help utility.

CHAPTER 5--PlateCrane Components

The Robotic Axes

The PlateCrane has the following axes:

1. R = rotates the PlateCrane horizontally
2. Z = moves the PlateCrane arm vertically
3. P = rotates the gripper horizontally
4. Y= extends/retracts the PlateCrane arm

The R-axis is driven by an encoded stepper motor. This axis has a rotational capability of 345°. It utilizes a hard stop to prevent continuous rotation, and a proximity sensor, which determines the "Home" position for the horizontal rotation.

The Z-axis is driven by an encoded stepper motor. This axis can travel up to 18 inches and complete a full stroke in less than three seconds. This axis utilizes a proximity sensor, which determines the "Home" position and uses the top and bottom plates as its hard stops.

The P-axis is driven by an encoded geared stepper motor. This axis has a rotational capability of 350°. It utilizes a hard stop to prevent continuous rotation, and a proximity sensor, which determines the "Home" position for the gripper rotation.

The Y-axis is driven by an encoded stepper motor. This axis can travel up to 6 inches and complete a full stroke in 2 seconds. This axis utilizes a proximity sensor, which determines the "Home" position, and uses the arm assembly for it's hard stop.

The standard gripper consists of a pair of gripper fingers that have two rubber inserts that provide a secure grip on microtiter plates. The lower part of the gripper "floats" vertically, and locates microtiter plates by using a proximity switch. This switch is located inside the gripper housing and indicates when the arm has encountered a microtiter plate. The outside edge of a microtiter plate activates the floating gripper. A centering plate is used to center microtiter plates inside the stack before the gripper picks them up.

Stacks

The standard PlateCrane includes two extruded aluminum stacks. Each stack can hold up to 30 standard-height microtiter plates. The stacks are from an aluminum extrusion for rigidity and precision. The stacks are held in position by plastic guide blocks on a stack base. The base is connected to the PlateCrane EX by three allen-head screws. The PlateCrane can be upgraded to have a maximum capacity of fifteen (15) stacks on three stack bases.

Power Cord/Communication Cable Connection

The power cord plugs into the AC inlet on the rear of the PlateCrane. Input power is either 120V or 230V, 50 or 60 Hz. The communication cable is connected from the rear of the PlateCrane to the chosen serial port on the computer (usually COM 1).

Power Switch

The power switch is located on the side plate with the power cord and communication cable (see Figure 11). It has a 0 and 1 engraved on it to show the OFF and ON power condition of the PlateCrane (refer to Figure11). PlateCrane power is ON when the switch is pressed in the 1 position and PWR LED on the rear of the PlateCrane is illuminated.

Optional Components

The following are additional items available for the PlateCrane:

- *Additional Stacks* -- Expands PlateCrane capacity of up to 450 microtiter plates (15 stacks).
- *Barcode Reader Kit* -- Enables the PlateCrane to identify individual microtiter plates by using bar code strips on the plates.
- *Device Interfaces* -- Enables PlateCrane to work in conjunction with specific laboratory instruments to process microtiter plates.
- *Instrument alignment bases* – Enables the instruments to be locked to the PlateCrane so they will not shift.
- *Vision Calibration System* – This allows the user to use a camera attached to the gripper with special calibration plates for teach PlateCrane positions. The camera makes workcell setup both faster and more accurate.
- *Teach Pendant* – This enables the end user to attached a teach pendant to the PlateCrane. The Teach pendant comes with control buttons for the R-axis, Z-axis, P-axis, Y-axis and also a limp button. The teach pendant saves time during setup, especially if used in conjunction with the Vision Calibration System.

CHAPTER 6--Hardware Specifications

General

Note: Specifications are subject to change without notice.

- Plate Capacity: Standard-- Up to 30 plates without lids or 25 plates with lids.
  Additional-- Up to 420 plates without lids or up to 350 plates with lids.
- Plate Format: Portrait & Landscape - (Rotary Gripper)
- Plate Storage Device: 2 removable stacks (expandable up to 15)
- Housing Material: Painted steel covering cast aluminum housing.
- Gripper Material: Black anodized aluminum; textured neoprene rubber inserts.
- Arm Mechanism: Ball bearing axis with high-speed screw rail; mechanical stops to prevent continuous rotation (345° maximum).

Robotic Arm

- Rotary Travel: 345°
- Horizontal Reach: from center of crane 12" – 18" radius
- Vertical Reach: Maximum 22.75 in. from table, minimum 4.25 in. from table, total 18.0 in. vertical travel distance.

Mechanical Description

- R-axis Stepper Motor: Encoded 200 steps per motor revolution; +/-0.025° resolution; approx. 3 seconds per full rotation (345°).
- Z-axis Stepper Motor: Encoded 200 steps per motor revolution; +/- 0.015mm resolution; approximately 1.5 seconds per complete vertical travel (one direction).
- Rotary Gripper Stepper Motor: 200 steps per motor revolution; +/- 0.030° resolution; approx. 4 seconds per full rotation (350°).
- Telescoping Motor: Encoded 200 steps per motor revolution; +/- 0.032mm resolution; approx. 1 second per full extension (6").

- Home Position: Proximity Switch for rotary and vertical arm home (zero) ranging, with encoder homing pulse for final home position.
- Plate Present: Proximity switch
- Plate Sensor: Proximity Switch.

Dimensions

- Height: 28.5in. - 29.0in. (27.7in. w/out footpads)
- Weight: ≈45 lbs.

Electrical

- Power Input: 120V / 230V AC, 50/60 Hz
  (Determined by position of fuse holder)
- Fuses: For 120V / 230V
  One 2A Time Delay, 5mm x 20mm
  (.205 in. x .787 in.)
- Grounding: Through the power cord, must be properly earth Grounded
- Computer Interface: RS-232 serial cable

Environmental

- Operating Temperature: 15° to 40°C (59° to 104°F)
- Operating Humidity: 0 to 85%, no condensation
- Storage Temperature: -20° to 65°C (-4° to 149°F)
- Altitude: Up to 2000m
- Ventilation Fans Require +2" of free space in front of them
  - Indoor Use Only

CHAPTER 7--Maintenance

Maintenance

WARNING- -

Qualified personnel can perform all maintenance procedures in this manual. Only Hudson representatives should perform any maintenance not discussed in this manual.

Gloves should be worn during any cleaning procedure.

Cleaning the PlateCrane

Note: DO NOT use/spray abrasive cleaners onto PlateCrane.

- Clean the outside surfaces of PlateCrane using cloth or sponge dampened with alcohol, water, or mild glass cleaner.
- Clean finger pads of gripper with alcohol or other residue-free solvent.
- Clean any spills on PlateCrane immediately.
- Only clean the exterior of the unit. DO NOT remove instrument covers to clean inside.
- Never allow water or fluid to leak inside the PlateCrane.

Change the Fuse(s)

Extra fuses are shipped with the PlateCrane. Fuses burn out occasionally and must be replaced. The following fuses are used with the PlateCrane:

- Metric: 1 x 2 amp, 5 x 20 mm Time Delay Fuse

WARNING- -

Be sure the power to the PlateCrane is OFF and the power cord is unplugged from the instrument or power source before proceeding with the following instructions.

☞ Turn the PlateCrane OFF and remove the power cord from the AC inlet on the back of Crane.

☞ Using a small flat head screwdriver, gently pry the fuse holder tray away from its housing to access the fuses (see Figure 17). The Fuse holder door swings down.

- ☞ Remove the blown fuse. Replace it with the spare fuse.
- ☞ Slide the fuse holder tray back into the AC inlet until it clicks. Make sure when re-installing the holder the AC line voltage reads the correct way on the inlet
- ☞ Reconnect the power cord to the PlateCrane and reconnect all other cables previously disconnected.
- ☞ Verify correct fuse replacement by turning the PlateCrane switch to ON position--the light will illuminate immediately.

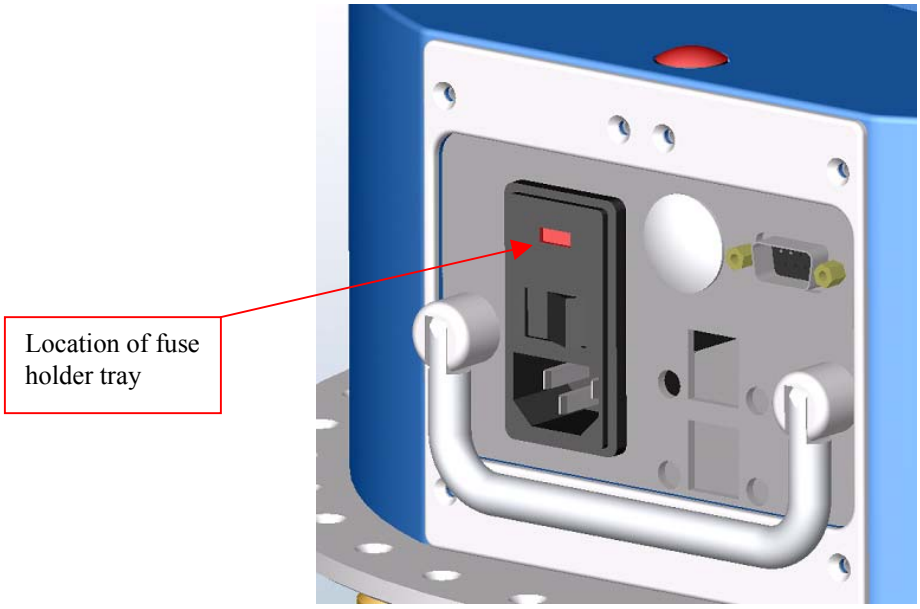

Figure 17

CHAPTER 8--Troubleshooting

For Troubleshooting Guide please contact Hudson Control Group

Appendix

Hudson's PlateCrane™ Communications and Command Set

Version 5.0

Hudson's PlateCrane is designed to respond to a simplified set of ASCII commands to allow any user program capable of reading/writing via an RS-232 port to exercise all the features of the PlateCrane.

Protocol Description

The RS-232 controller of the PlateCrane operates with the following communication specifications:

Baud Rate:	9600
Data Bits:	8
Stop Bits:	1
Parity:	None
Handshake:	None
Device Type:	DCE
Connector:	9-pin, female

All commands consist of an ASCII command, followed by a space and a list of comma-separated arguments (if appropriate), then a two-byte end-of-line carriage return/line feed, as in the example:

HERE STACK1<13><10>

The "<>" symbols are not actually part of the protocol, but are used here to denote bytes that are represented as their decimal number equivalent (i.e. <13> denotes a byte of value 13, a carriage return). The above command's individual byte values, for instance, would be:

H	E	R	E		S	T	A	C	K	1	<13>	<10>
72	69	82	69	32	83	82	65	67	75	49	13	10

Note: - commands are not case-sensitive and the space is important
- point names are case-sensitive

The PlateCrane will echo every byte back to the sender. Upon detecting the two bytes <13><10>, the controller will then execute the command. Upon completing execution, the controller will respond in one of two ways:

1. For query commands, where a data response is required, it will return:

ASCII Response, plus <13><10>

2. For action commands, it will return:
   2-byte ASCII error code, plus <16><13><10>

The "error code" will be two ASCII digits, from "00" to "99". "00" represents a correctly executed command. Any other response indicates an error. An invalid query command will produce a 01<16><13><10> response. As examples:

1. Valid query command:
   Command: INPUT R,2<13><10>
   Echo: INPUT R,2<13><10>
   Response: 0<13><10> (i.e., input no. 2 is OFF)

2. Valid action command:
   Command: CLOSE <13><10>
   Echo: CLOSE <13><10>
   Response: 00<16><13><10> (i.e., action successfully executed)

3. Invalid query command ("WASHER" is an unknown position):
   Command: GETPOINT WASHER <13><10>
   Echo: GETPOINT WASHER <13><10>
   Response: 02<16><13><10> (invalid point name)

Note: If any command contains an error, the PlateCrane sends the error code and <16><13><10> immediately, otherwise the 00<16><13><10> bytes are sent at the completion of execution.

Command Set

The PlateCrane recognizes the following commands:

1. CJOG Axis, Speed
   CJOG will cause the specified Axis to move at the indicated speed until a HALT is issued. Specifying a negative speed will reverse the direction of motion. Example:

   Command: CJOG P,-200 <13><10>
   Response: 00<16><13><10>

2. CLEARPOINTS
   CLEARPOINTS will delete all the points that are stored in the PlateCrane controller. Example:

   Command: CLEARPOINTS <13><10>
   Response: 00<16><13><10>

3. CLOSE
   CLOSE will close the PlateCrane's gripper.

   Example:

   Command: CLOSE<13><10>
   Response: 00<16><13><10>

4. DELETEPOINT Name
   DELETEPOINT will delete the point given by 'Name' from the point list in the PlateCrane memory. The PlateCrane will return an error if the point doesn't exist Example:

   Command: DELETEPOINT READER<13><10>
   Response: 00<16><13><10>

5. GETCONFIG
   GETCONFIG will return a number whose bits indicate the PlateCrane options:

   0 Rotary Option Present
   1 EX Arm Option Present
   2 Parallel Gripper Option Present
   3 PlateCrane E Series (Cannot be unset)

   Example:

   Command: GETCONFIG<13><10>
   Response: 11<13><10>

6. GETGRIPSTRENGTH

   GETGRIPSTRENGTH will return the current gripper strength setting. Strength settings are numbered 0-3, with 3 being the highest. (see SETGRIPSTRENGTH)

   Example:

   Command: GETGRIPSTRENGTH<13><10>
   Response: 3<13><10>

7. GETLIMITS

   GETLIMITS will return the PlateCrane minimum and maximum position limits for each axis. The order of the values in the response are:

   R low limit, R high limit, Z low limit, Z high limit, P low limit, P high limit, Y low limit, Y high limit
   (see SETLIMITS)

   Example:

   Command: GETLIMITS<13><10>
   Response: –150,14000,-12450,75,0,8500,-19000,200<13><10>

8. GETPOINT Name

   GETPOINT will return the PlateCrane R, Z, P, Y positions value given by 'Name'. The PlateCrane will return an error if the point doesn't exist (use the HERE command to teach a point)

   Example:

   Command: GETPOINT READER<13><10>
   Response: 1050,-4000,90,0<13><10>

9. GETPOS

   GETPOS will return the PlateCrane current R, Z, P, Y position values. An error will be returned if the PlateCrane hasn’t been homed.
   Example:

   Command: GETPOS<13><10>
   Response: 1050,-4000,90,0<13><10>

10. GETSPEEDS

GETSPEEDS will return the PlateCrane maximum speed for each axis. The order of the values in the response are:

Maximum R speed, Maximum Z speed, Maximum P speed, Maximum Y speed (see SETSPEEDS)

Example:

Command: GETSPEEDS <13><10>
Response: 10000,30000,4000,20000<13><10>

11. GETSWITCHTYPE SwitchNumber

GETSWITCHTYPE will return the type and active-state of the specified internal limit switch input. See SETSWITCHTYPE for more information.

Example:

Command: GETSWITCHTYPE 1<13><10>
Response: 1,0<13><10>

12. GETZCURRENT

GETZCURRENT will return the running current settings for the Z axis. The first number indicates the percentage of maximum current used when moving down, the second is the percentage used when moving up.
Example:

Command: GETZCURRENT<13><10>
Response: 15,45<13><10>

13. HALT

HALT will stop all current PlateCrane motion. It is the only command whose successful completion results in an error code other than "00".

Example:

Command: HALT<13><10>
Response: 15<16><13><10>

14. HERE Name

HERE will read the current PlateCrane position and store it in the PlateCrane's non-volatile memory with the given 'Name'. 'Name' can be any string up to 20 characters long. The PlateCrane can store up to 50 positions in its memory.

Example:

Command: HERE READER<13><10>
Response: 00<16><13><10>

15. HOME

HOME will home the PlateCrane Y, Z, R, and P axes. The PlateCrane first will home the Y-axis, the Z-axis and then the R and P axes.

Example:

Command: HOME<13><10>
Response: 00<16><13><10>

16. JOG Axis,Steps

JOG will move the axis 'Axis' the number of steps given by 'Steps' relative to the current position of the PlateCrane.

Example:

Command: JOG Z,-1000<13><10>
Response: 00<16><13><10>

Command: JOG P,45<13><10>
Response: 00<16><13><10>

17. LIMP PowerOn

LIMP will restore or remove power from the PlateCrane motors, depending on the value of PowerOn. If PowerOn is a 1, the motors will be powered. If PowerOn is a 0 power will be removed. Other values are invalid. This will allow the user to move the arm manually. The encoder positions will continue to update while motor power is off.

Example:

Command: LIMP 0<13><10>
Response: 00<16><13><10>

18. LISTPOINTS

LISTPOINTS will list all the points that are stored in the PlateCrane memory.

Example:

Command: LISTPOINTS<13><10>
Response: 1:STACK1, 1000,-7000,0,-300<13><10>
2:STACK2, 1350,-7000,0,-300<13><10>
3:READER, 8500,-5670,1,-18024<13><10>
4:BARCODE, 4500,-2700,1,-18341<13><10>
<13><10>

19. LOADPOINT Name,Rpos,Zpos,Ppos,Ypos

LOADPOINT will load the point name and the positions that are given by Rpos, Zpos, Ppos,Ypos into the PlateCrane none volatile memory. This command should be executed when it is required to load a position from backup.

Example:

Command: LOADPOINT READER,4550,-7865,0,-1000<13><10>
Response: 00<16><13><10>

20. MOVE Name

MOVE will move the plate crane to the taught point given by 'Name'.

Example:

Command: MOVE READER<13><10>
Response: 00<16><13><10>

21. MOVE_ABS Axis,Position

MOVE_ABS will move the axis 'Axis' to the absolute position given by 'Position'.

Example:

Command: MOVE_ABS Z,-1000<13><10>
Response: 00<16><13><10>

Command: MOVE_ABS P,45<13><10>
Response: 00<16><13><10>

22. MOVE_P Name

MOVE_P will move the PlateCrane P axis to the taught point given by 'Name'.

Example:

Command: MOVE_P READER<13><10>
Response: 00<16><13><10>

23. MOVE_R Name

MOVE_R will move the PlateCrane R axis to the taught point given by 'Name'.

Example:

Command: MOVE_R READER<13><10>
Response: 00<16><13><10>

24. MOVE_Y Name

MOVE_Y will move the PlateCrane Y axis to the taught point given by 'Name'.

Example:

Command: MOVE_Y READER<13><10>
Response: 00<16><13><10>

25. MOVE_Z Name

MOVE_Z will move the PlateCrane Z axis to the taught point given by 'Name'.

Example:

Command: MOVE_Z READER<13><10>
Response: 00<16><13><10>

26. OPEN

OPEN will open the PlateCrane's gripper.

Example:

Command: OPEN<13><10>
Response: 00<16><13><10>

27. READINP Number

READINP will return the current state of the digital input 'Number', returning "0" (OFF) or "1" (ON). 'Number' can have the values "1" through "48" for the input address:

"1" is the R axis home switch
"2" is the Z axis home switch
"3" is the Stack Height sensor
"4" is the Gripper Fully Closed sensor
"5" is the Rotary Gripper home switch
“6-8” are unused
“9-12” are JackRabbit Port B inputs 2-5
“13” is the left Address Input (JackRabbit Port D input 0)
“14” is the right Address Input (JackRabbit Port D input 3)
“15” if the R axis home switch
“16”-“18” are the R axis driver inputs 2-4
“19”-“20” are unused
“21” is the Z axis home switch
“22” is the Stack Height sensor
“23”-“24” are the Z axis driver inputs 3-4
“25”-“26” are unused
“27” is the P axis lower limit
“28” is the P axis upper limit
“29”-”31” are the P axis driver inputs 0-2
“32” is the P axis home switch
“33” is the Y axis lower limit
“34” is the Y axis upper limit
“35”-“37” are the Y axis driver inputs 0-2
“38” is the Y axis home switch
“39”-“40” are unused
“41”-“48” are the Teach Pendant inputs (JackRabbit Port A 0-7)

Command: READINP 1<13><10>
Response: 0<13><10> (input is off)

28. SET Source, Destination

SET will copy the PlateCrane coordinates of position name 'Source' to the position name given by 'Destination'.

Example:

Command: SET READER,TEMP<13><10>
Response: 00<16><13><10>

29. SETCONFIG config_pattern

SETCONFIG will set the PlateCrane options present on this PlateCrane. Each bit of the configuration pattern indicates an option.

0 Rotary Gripper
1 EX Arm
2 Parallel Gripper
3 PlateCrane E Series (will be set regardless of indicated value)

Example:

Command: SETCONFIG 11<13><10>
Response: 00<16><13><10>

30. SETGRIPSTRENGTH strength

SETGRIPSTRENGTH will set the PlateCrane gripper strength. Valid settings are 0-3 with 3 being the strongest.

Example:

Command: SETGRIPSTRENGTH 3<13><10>
Response: 00<16><13><10>

31. SETLIMITS Rmin,Rmax,Zmin,Zmax,Pmin,Pmax,Ymin,Ymax

SETLIMITS will set the minimum and maximum position limits for each axis, as given by Rmin, Rmax, Zmin, Zmax, Pmin, Pmax, Ymin, Ymax. The P axis limits are optional and are only used with the rotary gripper option. (see GETLIMITS)

Example:

Command: SETLIMITS –150,14000,-12450,75,0,8500,-19000,200<13><10>
Response: 00<16><13><10>

32. SETSPEEDS RSpeed,[ZSpeed],[PSpeed],[YSpeed]

SETSPEEDS will set the PlateCrane maximum speed for each axis (see GETSPEEDS)

Example:

Command: SETSPEEDS 10000,30000,4000,20000<13><10>
Response: 00<16><13><10>

33. SETSWITCHTYPE SwitchNumber, Type, ActiveState

SETSWITCHTYPE will set an internal PlateCrane limit switch to the specified Type and ActiveState. Can be used to change the function of a given sensor.

The SwitchNumbers and their standard use are:

1 R-Axis Home switch
2 Unused
3 Unused
4 Unused
5 Z-Axis Home switch
6 Z-Axis Low Limit switch (Plate Detection switch in the gripper)
7 Unused
8 Unused

Valid Types are:

0 Generic Read Switch (default for unused switches)
1 Home
2 + Limit
3 - Limit
4 Go
5 Soft Stop
6 Pause
7 + Jog
8 - Jog

ActiveStates are:

0 Active Low (switch is "ON" when grounded or at 0V)
1 Active High (switch is "ON" when powered or above 5V)

Example: (re-casts the Z-Axis Low Limit switch as a generic input)

Command: SETSWITCHTYPE 6,0,0<13><10>
Response: 00<16><13><10>

34. SETZCURRENT DownCurrent, UpCurrent

SETZCURRENT will set the PlateCrane Z-Axis running current to the specified percentages. DownCurrent specifies the percentage of current to use when moving down. UpCurrent specifies the percentage to use when moving up.

Example:

Command: SETZCURRENT 15,45<13><10>
Response: 00<16><13><10>

35. SHIFT Point,Rpos,Zpos,Ppos,Ypos

SHIFT will shift the point name Point by the axis positions given by Rpos, Zpos, Ppos and Ypos. All values represent stepper pulses.

Example:

Command: SHIFT READER,100,-2000,45,0<13><10>
Response: 00<16><13><10>

36. SPEED Speed

SPEED will set the PlateCrane movement speed to the variable 'Speed' percent of full speed. 'Speed' can have any value 1 to 100.

Example:

Command: SPEED 50<13><10>
Response: 00<16><13><10>

37. STATUS

STATUS will return the PlateCrane current status.

0 – Not Initialized
1 - Initialized
Example:

Command: STATUS<13><10>
Response: 0<13><10>

Command: STATUS<13><10>
Response: 1<13><10>

38. TEACH mode

The TEACH command enables or disables the Teach Pendant. A 1 activates the Teach Pendant, while a 0 disables it. The Teach Pendant is enabled by default on power-up. It is recommended that this command be issued to prevent user interference during computer operation of the PlateCrane.

Example:

Command: TEACH 1<13><10>
Response: 00<16><13><10>

39. TERMINAL

TERMINAL will set the PlateCrane controller in terminal mode. When the PlateCrane is in terminal mode incoming characters from the host are sent directly to the motor controllers. This will enable the user to operate the individual axes using the controller's own command language. To disable the terminal mode, type TERMINAL again. To operate the Y and P axes in single-mode the command "YA56" or "PA56" should be sent to the driver. This will place the driver in single-mode until the drivers are reset by sending an ASCII 3, or until the command "A24" is sent. The Z and R axes can be placed in single mode by sending the command "ZPY 0" or "RPY 0". This will place the driver in single-mode until the drivers are reset by sending an ASCII 3, or until the command "PY 1" is sent.

Example:

Command: TERMINAL<13><10>
Response: 00<16><13><10>

40. VERSION

VERSION will report the PlateCrane firmware version

Command: VERSION<13><10>
Response: PlateCrane v5.0<13><10>

41. WRITEOUT Number, State

WRITEOUT will set output 'Number' to the state given by 'State' ("1" = ON, "0" = OFF). All other outputs are left unaffected. 'Number' can have the values "1" through "36" for the output address:

"1”-“8" are JackRabbit Port A outputs 0-7 (not currently available)
"9" is the left Address output (JackRabbit Port B output 6)
"10" is the right Address output (JackRabbit Port B output 7)
“11”-“12” are JackRabbit Port D outputs 6-7
“13”-“16” are JackRabbit Port E outputs 0-3 and High Current Outputs 0-3
“17”-“18” are JackRabbit Port E outputs 4-5
“19” is JackRabbit output PCLK
“20” is JackRabbit output IOBEN
“21”-“24” are the R axis driver outputs 1-4
“25”-“29” are the Z axis driver outputs 1-4
“30” is the open gripper output
“31” is the close gripper output
“32” is the P Axis Party Mode output
“34” is the second Grip Strength output
“35” is the first Grip Strength output
“36” is the Y Axis Party Mode output

Command: WRITEOUT 1,0<13><10> (turn output 1 off)
Response: 00<16><13><10>

Command: WRITEOUT 3,0<13><10> (turn output 3 on)
Response: 01<16><13><10> (error: invalid output)

Error Code Description

The PlateCrane controller will report one of the following response codes at the completion of each command:

00 Command completed successfully.
01 Invalid command or parameter.
02 Invalid point name
03 Maximum number of points exceeded
04 IMS communication transmit error
05 IMS communication response error
06 Move command wasn't complete
07 Home command wasn't complete
08 Invalid target position
09 PlateCrane is not homed
10 R axis position is out of the dead-band limit
11 Z axis position is out of the dead-band limit
12 P axis position is out of the dead-band limit
13 Invalid rotary option.
14 Plate present
15 Motion halt
16 No plate in gripper
17 Y axis position is out of the dead-band limit

Warranty & Service Agreement Terms and Conditions

A. Warranty

a. One-year coverage beginning on the factory ship date on all parts and labor including return shipping (to the customer) via UPS ground or equivalent. Warranty is limited to components and software purchased from or provided by Hudson Control Group, Inc.
b. Technical support by trained personnel via telephone or email during normal business hours will be provided at no cost (exclusive of telephone toll charges incurred by the customer) during the warranty period.
c. Hudson Control Group, Inc. will provide on-site service during the warranty period, excluding Micro1 and Micro10 instruments.
d. Factory repair services are available for all products, under the following conditions:
    1. The customer is responsible for packing of instrument and shipping to Hudson. The customer will be notified of non-warranty repair costs, if any, prior to the repair being started.
    2. Damage incurred in transit to Hudson including, but not limited to, damage due to improper packing will be the responsibility of the customer and / or shipper. The customer is advised to retain the original packing material, including the cast foam padding, in the event service is required. Replacement packing materials are available from Hudson at cost-plus shipping (currently ~$175.00).
    3. Hudson will pay return shipping to customer, via UPS ground or equivalent. Expedited shipping is available at additional cost.
e. Updates to correct performance anomalies shall be provided at no cost during the warranty period subject to the warranty terms and conditions.
f. Upgrades, which provide additional functionality, may be offered at reduced costs during the warranty period.
g. Factory repairs must be pre-authorized by Hudson Control Group, Inc. and will include issuance of a Returned Materials Authorization (RMA) number. Customer certification of decontamination is required prior to return of any instrument(s) for factory service (instruments not certified decontaminated may be refused service and returned at customer's expense).
h. While Hudson Control Group, Inc. makes every effort to provide software and instruments suitable to
a wide range of automation tasks, no guarantee is made as to the suitability of the hardware and/or
software provided for a given application unless so stated in the written purchase agreement.
i. Repair of failures, caused by but not limited, to misuse, fire, flood or other act of God, chemical or
environmental exposure, or repair by persons not authorized by Hudson Control Group, Inc. may, at
the sole discretion of Hudson Control Group, Inc., be charged at the prevailing hourly service rate

(currently $120/hr for Factory Service, $120/hr for travel time and $240/hr for Field Service).

B. Service Agreements,

Service Agreements in one-year periods are available at prevailing rates and provide the following coverage in addition to the original warranty:

a. One scheduled onsite maintenance service call per year of coverage to include evaluation and adjustments/repairs to meet instrument performance specifications.
b. Inspection and replacement of marginal components.
c. All applicable hardware and software updates.
d. If previous warranty or service agreement coverage has expired for more than 30 days pre-inspection and repair of instrument at customers expense prior to start of service coverage may be required.
e. Pre-inspection may, at the service director's discretion, be provided in place of the one scheduled onsite maintenance at no charge beyond that of the service agreement.
f. Onsite service is priced by travel time to customer from an established Hudson site.
    1. **Zone I**: Massachusetts, Connecticut, Rhode Island, New Jersey, New York, Pennsylvania, Delaware, and Maryland, and California north of Santa Barbara.
    2. **Zone II**: All other.
g. Payment terms are net thirty (30) days after the date of invoice. Customer will be invoiced. In case of delayed payment, Hudson Control reserves the right to decline service.
h. This agreement may be terminated by either party upon default by the other party of any material obligation under this Agreement which default continues for thirty (30) days after written notice has been provided by the non-defaulting party.

II. **General Conditions.** These apply to all products under warranty or service agreement.

a. **Excluded parts.** Covered parts do not include chemicals, reagents, customer replaceable items, consumables, or other parts listed in the operator's or instruction manual as customer replaceable parts, sub-assemblies or accessories. Replacement of these items will be billed at prevailing rates.
b. Hudson Control reserves the right to use repaired parts during the Coverage Period. For parts that have been replaced, Hudson Control is the sole owner of these parts and they cannot be sold or repaired by

the customer or any third party.

c. **Key operator.** Customer shall designate a key operator to a Hudson Control representative by telephone or email. Such operator shall be qualified to perform simple adjustments or corrections as requested by a Hudson Control representative. Failure to perform customer maintenance as specified in the Instrument Instruction Manual may result at Hudson Control's option in 1) cancellation of this Agreement or 2) a service call invoiced by Hudson Control at its standard rates for service including travel.

d. **Warranty and service coverage does not include the following.** Any service calls made as the result of the below shall be invoiced by Hudson Control at their standard rates including travel and labor expenses:

1. Damage caused by Customer misuse or operation outside of conditions prescribed in the Instruction Manual.
2. Damage caused by electrical surges or the use of improper sources, intervention of a third party, external influences such as fire, water damage, natural disaster, etc.
3. Relocation of the instrument.
4. Use of chemicals and accessories outside the specifications contained in the Instruction Manual.
5. Applications related issues.
6. Computer/ Hard drive crashes and failures

e. **Safe Working Environment.** Customer shall provide the Hudson Control representative with facilities at Customer's location that comply with the applicable regulations of the Secretary of Labor promulgated under the Occupational, Safety and Health Act of 1970.

f. This agreement sets forth the entire agreement and understanding between Hudson Control and Customer regarding service of the Instruments covered hereunder. This agreement may be modified only by writing and by authorized representatives of the parties.

III. **Custom Service Packages** providing features to meet individual customer requirements may be arranged.

Contact your sales representative or Hudson's service director for availability and pricing.